

Set 4. Conversions

Skill 4.01: Be able convert one quantity to another using a conversion factor

Skill 4.02: Be able to convert one quantity to another using more than one conversion factor (i.e. chain conversions)

Skill 4.03: Apply chain conversions to convert quantities reported with multiple units

Skill 4.04: Be able to convert Celsius temperature to Kelvin temperature and visa versa

Skill 4.01: Be able convert one quantity to another using a conversion factor

Skill 4.01 Concepts

Conversion factors are used to convert a quantity from one set of units to another. They can be recognized because they always have two different units.

For example, there are 60 seconds in 1 min. Another way to state this is 60 seconds = 1 min.

Example: Convert 3.50 minutes into seconds

Step 1: Write the given amount

3.50 minutes

Step 2: Identify the needed conversion factors

60 seconds = 1 min

Step 3: Rearrange your conversion so that the units you are converting to appear on top and the units you are converting from appear on the bottom

$$\frac{60 \text{ seconds}}{1 \text{ min}}$$

Step 4: Multiply the given amount by the conversion factor

$$3.50 \text{ min} \times \frac{60 \text{ seconds}}{1 \text{ min}} = 210 \text{ seconds}$$

Step 5: Round to the appropriate significant figures

NEVER round to the conversion factor. This is considered an exact number. The given amount 3.50 minutes has 3 significant figures. The final answer 210 has 2 significant figures. In order to correctly report this value to 3 significant figures, a decimal must be added to the end of the number: 210. seconds.

Skill 4.01 Example 1

(a) How much is 145 lbs in kilograms?
(1 lb=0.4536 kilograms)

$$145 \text{ lbs} \times \frac{0.4536 \text{ Kg}}{1 \text{ lb}} = 65.7 \text{ Kg}$$

(b) How much is 50. g in lbs?
(1000 g=1 kg)

$$50. \text{ g} \times \frac{1 \text{ Kg}}{1000} = 0.050 \text{ Kg}$$

Skill 4.01 Exercise 1

Skill 4.01 Example 2

- (a) Record the measurement shown in the figure in mL.



9.62 mL

- (b) How much is this amount in cm^3 ? (1 mL = 1 cm^3)

9.62 cm^3

- (c) How much is the amount in (a) in Liters?

$$9.62 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.00962 \text{ L}$$

- (d) How much is this amount in in^3 ? (1 in = 2.54 cm)

$$9.62 \text{ cm}^3 \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} =$$

Although volume can be measured directly, using a graduated cylinder or a buret (as shown in figure 1), volume is actually a derived quantity. A derived quantity is one that can be calculated. For example, if you know the dimensions of a block of wood, you can calculate the volume.

587
 in^3

Skill 4.01 Example 3

- (a) What is the volume of piece of wood with the following dimensions:
Length = 10. cm; Width = 5.0 cm; Height = 8.0 cm

$$V = 10 \times 5 \times 8 = 400 \rightarrow 4.0 \times 10^2 \text{ cm}^3$$

- (b) What is the volume of the piece of wood in m^3 ? (100 cm = 1 m)

$$4.0 \times 10^2 \text{ cm}^3 \times \frac{1 \text{ m}}{100 \text{ cm}} \times \frac{1 \text{ m}}{100 \text{ cm}} \times \frac{1 \text{ m}}{100 \text{ cm}} =$$

Skill 4.01 Exercise 2

$$4.0 \times 10^{-4} \text{ m}^3$$

Skill 4.02: Be able to convert one quantity to another using more than one conversion factor (i.e. chain conversions)

Skill 4.02 Concepts

Sometimes we need to apply several conversions to achieve our final result. For example, we know that there are 12 inches in a foot, we also know that there are 2.54 cm in an inch. But, how many centimeters are in a foot? This type of calculation requires to steps,

foot → inches → centimeters

While we can do this calculation in two separate steps, the steps can also be combined as follows,

$$1 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 30.48 \text{ cm}$$

Skill 4.02 Exercise 1

Skill 4.03: Apply chain conversions to convert quantities reported with multiple units

Skill 4.03 Concepts

Chain conversions can be applied when one needs to convert more than 1 unit in a quantity. For example density can be reported in g/mL. If one wanted to report this as mg/L, they would need to convert both g and mL.

Example: Convert 3.50 g/mL to mg/L

Step 1: Write the given amount

$$3.50 \text{ g/mL OR } \frac{3.50 \text{ g}}{\text{mL}}$$

Step 2: Identify the needed conversion factors. For the numerator, 1 g = 1000 mg. For the denominator, 1000 mL = 1 L

Step 3: Rearrange the numerator conversion factor so that the unit you are converting to appears on top. Rearrange the denominator conversion factor so that the unit you are converting to appears on the bottom.

$$\frac{1000 \text{ mg}}{1 \text{ g}} \quad \frac{1000 \text{ mL}}{1 \text{ L}}$$

Step 4: Multiply the given amount by the conversion factors

$$\frac{3.50 \text{ g}}{\text{mL}} \times \frac{1000 \text{ mg}}{1 \text{ g}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 3,500,000 \text{ mg/L}$$

Step 5: Round to the appropriate significant figures

Again, NEVER round to the conversion factor. This is considered an exact number. The given amount 3.50 g/mL has 3 significant figures. The final answer should there for be reported as $3.50 \times 10^6 \text{ mg/L}$.

Skill 4.03 Example 1

Given the following data,

Length = 11 cm

Width = 15 cm

Height = 20. cm

Mass = 2.00 g

(a) calculate the density of the block of wood

(b) What is the density in Kg/m^3 ?

(c) What is the density in lbs/in^3 ? (1 lb = 0.4536 kilograms; 1 in = 2.54 cm)

Skill 4.03 Exercise 1

Skill 4.04: Be able to convert Celsius temperature to Kelvin temperature and visa versa

Kelvin is a unit of temperature frequently used in chemistry. 0°C is equal to 273 K or,

$$K = ^\circ\text{C} + 273$$

$$^\circ\text{C} = K - 273$$

Skill 4.04 Example 1

(a) Convert the temperature of water at 23°C into Kelvin.

$$K = 23 + 273$$
$$= 296 K$$

(b) Absolute zero is -273°C . What is this temperature K?

$$K = -273 + 273$$
$$= 0 K$$

(c) What is 80. K in Celsius?

$$^\circ\text{C} = 80 - 273$$
$$= -193^\circ\text{C}$$

Skill 4.04 Exercise 1

$^\circ\text{C}$ K

$0 \rightarrow$